Applications of the 3-Dimensional Cross Correlation Technique in Static and Dynamic Light Scattering

W. Schröer, M. Kleemeier, M. Schröder, and S. Wiegand
Institut für Anorganische und Physikalische Chemie
Universität Bremen
28359 Bremen, Germany

In conventional light scattering experiments the presence of multiple scattering obscures the analysis of the intensity and of the correlation functions when the sample is highly turbid. Cross correlation techniques provide an experimental means to separate the contributions of singly from multiply scattered light. By combining the conventional and the cross-correlation technique it is possible to determine the intensities and the time correlation functions for the singly and multiply scattered light separately. Different techniques have been proposed and successfully applied [1].

We report experiments using the so called “3-dimensional coding” technique. In this method the light scattered in two different scattering planes is cross-correlated [2,3]. The two scattering geometries have the same scattering volume and identical scattering vector. We demonstrate that even in highly turbid latex solutions the correlation function of the single-scattering is a single exponential and that the scattering cross-section of the particles (Mie-region) can be determined from the angular dependence of the amplitude. Furthermore, considering the multiple scattering contributions, we find good agreement of the experimental data with Monte-Carlo simulations of the scattering processes.

The technique is also applied to study the temperature dependence of the critical fluctuations in a solution of polystyrene in cyclohexane. The system belongs to the Ising-universality class. Over the entire temperature range the single scattering intensity can be described by the Ornstein-Zernike function while the decay of the correlation function follows the predictions of mode coupling theory.

[1] K. Schätzel, *J. Mod. Opt*. **38**, 1849 (1991).
[2] L.B. Aberle, P. Hülstede, S. Wiegand, W. Schröer, and W. Staude, *Appl. Opt*. **37**, 6511 (1998).
[3] E. Overbeck and C. Sinn, *J. Mod. Optics* **46**, 303 (1999).